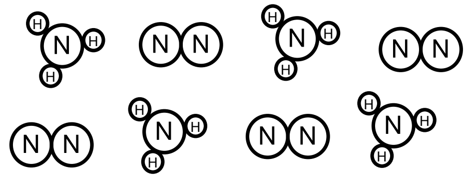
Questions 4, 97, 98, 99, 101, 103, 104, 105

4) $N_2 + 3H_2 \longrightarrow 2NH_3$

H_2 is the limiting reactant, so there will be 4 N_2 leftover.



97) $2NO + O_2 \longrightarrow 2NO_2$

Since O_2 is leftover, NO was the limiting reactant.

98) *There would be 22 molecules after the reaction; 20 would be products (8NO + 12H_2O) plus there would be 2 molecules of NH_3 leftover.*

99)

1.50 g BaO_2	1 mol BaO_2	1 mol H_2O_2	34.016g H_2O_2	= 0.301 g H_2O_2
	169.33g BaO_2	1 mol BaO_2	1 mol H_2O_2	

25.0 ml HCl	0.0272g HCl	1 mol HCl	1 mol H_2O_2	34.016g H_2O_2	= 0.317 g H_2O_2
	1 ml HCl	36.458g HCl	2 mol HCl	1 mol H_2O_2	

0.016 g H_2O_2	1 mol H_2O_2	2 mol HCl	36.458g HCl	= ***0.034g HCl leftover***
	34.016g H_2O_2	1 mol H_2O_2	1 mol HCl	

101) Since more moles of O_2 are needed and it has the greatest mass, you can tell that O_2 will be the limiting reactant.

5.00 x 10^6 g O_2	1 mol O_2	2 mol HCN	27.028g HCN	= ***2.82 x 10^6 g HCN***
	32.00g O_2	3 mol O_2	1 mol HCN	

↘

6 mol H_2O	18.016g H_2O	= ***5.63 x 10^6 g H_2O***
3 mol O_2	1 mol H_2O	

103) Less $C_7H_6O_3$ is available AND it has a greater mass, so it is the limiting reactant.

1.50 g $C_7H_6O_3$	1 mol $C_7H_6O_3$	1 mol $C_9H_8O_4$	180.154g $C_9H_8O_4$	= ***1.96 g $C_9H_8O_4$***
	138.118g $C_7H_6O_3$	1 mol $C_7H_6O_3$	1 mol $C_9H_8O_4$	

$$\frac{1.50 \text{ g actual}}{1.96 \text{ g theoretical}} \times 100 = \textbf{\textit{76.5\% yield}}$$

104) a.

$$\frac{485\text{ g } C_2HOCl_3}{} \times \frac{1\text{ mol } C_2HOCl_3}{147.38\text{ g } C_2HOCl_3} \times \frac{1\text{ mol } C_{14}H_9Cl_5}{1\text{ mol } C_2HOCl_3} \times \frac{354.46\text{g } C_{14}H_9Cl_5}{1\text{ mol } C_{14}H_9Cl_5} = \mathbf{1170g\ C_{14}H_9Cl_5}$$

b. chloral is the limiting reactant; chlorobenzene the excess reactant

c. $$\frac{1166\text{g } C_{14}H_9Cl_5}{} \times \frac{1\text{ mol } C_{14}H_9Cl_5}{354.46\text{g } C_{14}H_9Cl_5} \times \frac{2\text{ mol } C_6H_5Cl}{1\text{ mol } C_{14}H_9Cl_5} \times \frac{112.55\text{g } C_6H_5Cl}{1\text{ mol } C_6H_5Cl} = 740.\text{g } C_6H_5Cl$$ *needed*

1142g - 740.g = 401 g excess

d. $$\frac{200.\text{ g actual}}{1170\text{ g theoretical}} \times 100 =$$ ***17.1% yield***

105)

$$\frac{2.50\text{ tonnes } Cu_3FeS_3}{} \times \frac{1 \times 10^6\text{ g}}{1\text{ metric ton}} \times \frac{1\text{ mol } Cu_3FeS_3}{342.71\text{g } Cu_3FeS_3} \times \frac{6\text{ mol Cu}}{2\text{ mol } Cu_3FeS_3} \times \frac{63.55\text{ g Cu}}{1\text{ mol Cu}} = 1.39 \times 10^6\text{ g Cu}$$

or

1.39 metric tons

$$\frac{X}{1.39\text{ metric tons}} \times 100 = 86.3\%\text{ yield}$$

X = 1.20 metric tons